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HIGH-POWER HARMONIC SUPPRESSION FILTERS

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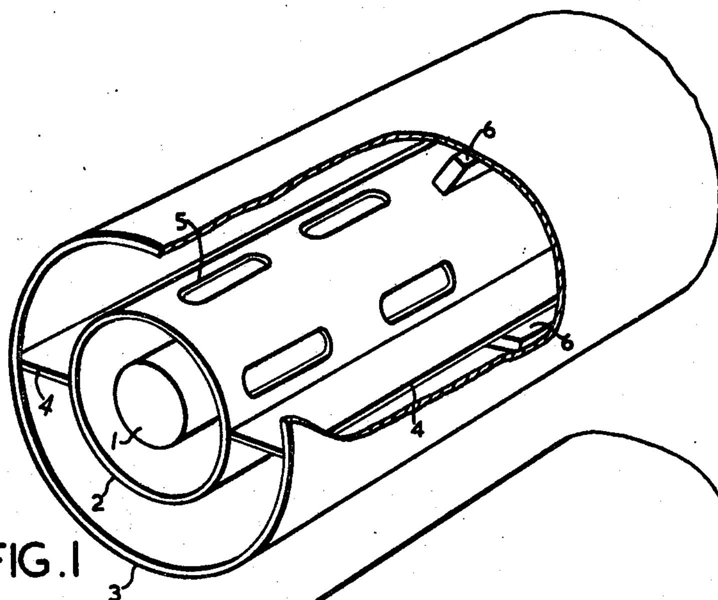

FIG. 1

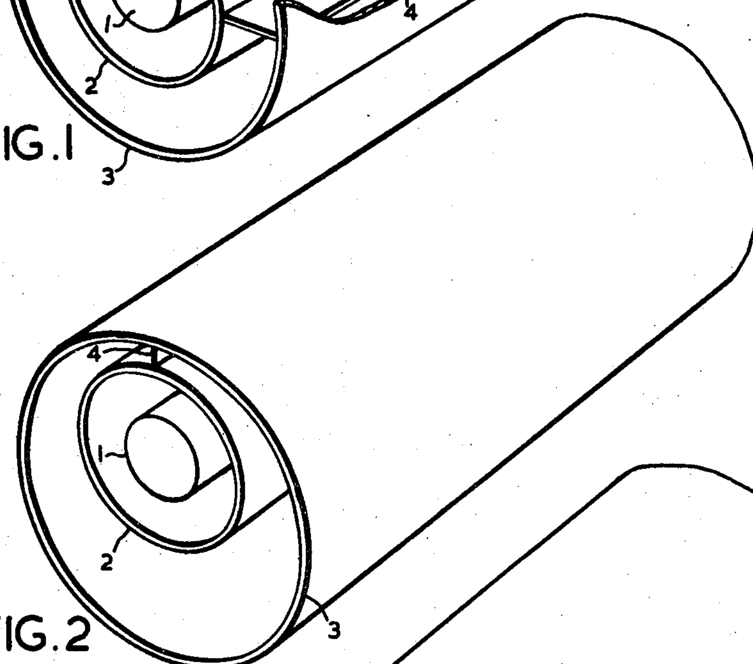

FIG. 2

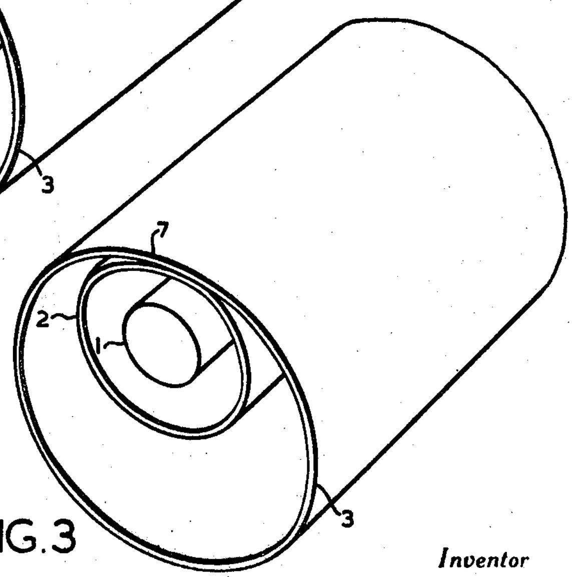

FIG. 3

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HIGH-POWER HARMONIC SUPPRESSION FILTERS

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U.S. Cl. 333—73 7 Claims

ABSTRACT OF THE DISCLOSURE

A high power harmonic suppression filter including a coaxial transmission line, at least a portion thereof being surrounded by a waveguide. The outer conductor of the coaxial line is connected to the waveguide by means of at least one septa to form a separate coaxial waveguide or lunar waveguide. Further provided are coupling means such as slots in the outer conductor of the coaxial line for coupling harmonic power from the coaxial line to the waveguide and energy absorbing means within the waveguide for absorbing the coupled harmonic power.

This invention relates to high-power harmonic suppression filters.

Absorption type harmonic suppression filters have previously been described using rectangular waveguides for the main transmission, but their operation has been limited to cut-off frequencies above about 500 mc./s. Such prior art devices are described in Price et al., "Harmonic Suppression by Leaky-Wall Waveguide Filter," IRE WESCON Convention Record 1959, part 1, page 112; and Met, "Absorptive Filters for Microwave Harmonic Power," proceedings of the IRE, volume 47, 1959, page 762. Coaxial reflection type filters have also been described but these must be so dimensioned that only the TEM mode can propagate up to at least the frequency of the 4th or 5th harmonic. These prior art devices are described, for example, in Radio Res. Lab. Staff, VHF Techniques, chapters 26 and 27, McGraw-Hill, New York, 1947. The present invention enables absorption type filters to be designed which have substantially lower operating frequencies than the previously described rectangular waveguide type, and which can have a 4- or 5-fold greater diameter than the coaxial reflection type filter and thus have a greatly increased power-handling capacity.

According to this invention a high-power harmonic suppression filter comprises a coaxial transmission line along which high-frequency electromagnetic energy may be transmitted, a waveguide surrounding part of the length of the coaxial line and formed as a septate coaxial waveguide or lunar line having as one member thereof the outer member of the coaxial line, coupling means between the coaxial line and waveguide, and energy absorption means in the waveguide.

Reference will now be made to the drawings in which;

FIGURE 1 is a diagrammatic drawing of a coaxial filter according to this invention, with part of an outer member partly broken away,

FIGURE 2 is a simplified drawing of a modification, and

FIGURE 3 is a simplified drawing of a second modification.

Referring first to FIGURE 1, a main coaxial transmission line is provided along which the high-frequency electromagnetic energy is propagated, the line comprising inner and outer conductors **1** and **2** respectively. The coaxial line is surrounded by a septate coaxial waveguide

formed by the outer member or tube **2** of the coaxial line, a member or tube **3** which surrounds and is concentric with the tube **2**, and one or more septa **4** joining the tubes **2** and **3**. Slots **5** are provided in the tube **2** to couple harmonic power from the coaxial line to the waveguide. Other coupling means such as holes, probes or loops could be used. The filter is designed so that at the fundamental frequency only the TEM mode can propagate in the main coaxial line, and no energy can propagate in the septate waveguides, while the dominant transverse-electric mode can propagate in the waveguides at the second (and higher) harmonic frequencies. The region between tubes **2** and **3** is provided with means such as **6** for absorbing the harmonic power. The absorbing means **6** may take the form of strips, wedges or cylinders of lossy material, such as iron, carbon or water.

The members **2, 3** forming the waveguide need not be coaxial, but may be eccentric, as shown in FIGURES 2 and 3, when they are shown as lunar lines. In FIGURE 2 one septum **4** is shown. In FIGURE 3 the members **2, 3** are in line contact at **7** and this effectively forms a septum.

By suitable design of the coupling means **5** the peak and average power rating of the filter can be made about the same as that of a coaxial transmission line of the same outer diameter as that of member **2**. While I have described above the principles of my invention in connection with specific apparatus, it is to be clearly understood that this description is made only by way of example and not as a limitation to the scope of my invention as set forth in the accompanying claims.

What I claim is:

1. A high power harmonic frequency suppression filter comprising:
- a coaxial transmission line having an inner and outer conductor, said coaxial transmission line being dimensioned such that at the fundamental frequency of said filter only the TEM modes can propagate therein;
- a waveguide surrounding at least a portion of the length of said coaxial transmission line;
- means connecting the outer conductor of said coaxial line to said waveguide to prevent the TEM mode at said fundamental frequency from propagating in said waveguide said connecting means including at least one conducting septum coupling the outer conductor of said coaxial transmission line to said waveguide;
- means electrically coupling said coaxial transmission line to said waveguide; and
- energy absorption means mounted within said waveguide to absorb harmonic frequencies.

2. A high power harmonic frequency suppression filter according to claim **1** wherein said connecting means includes at least two conducting septa coupling the outer conductor of said coaxial transmission line to said waveguide.

3. A high power harmonic frequency suppression filter comprising:
- a coaxial transmission line having an inner and outer conductor, said coaxial transmission line being dimensioned such that at the fundamental frequency of said filter only the TEM modes can propagate therein;
- a waveguide surrounding at least a portion of the length of said coaxial transmission line;
- means connecting the outer conductor of said coaxial line to said waveguide to prevent the TEM mode at said fundamental frequency from propagating in said waveguide said connecting means including means joining the outer conductor of said coaxial

transmission line to said waveguide along a line substantially parallel to the longitudinal axis of said waveguide to form a lunar waveguide;

means electrically coupling said coaxial transmission line to said waveguide; and

energy absorption means mounted within said waveguide to absorb said harmonic frequencies.

4. A high power harmonic frequency suppression filter according to claim **3** wherein said waveguide is dimensioned such that it is cut off at the fundamental frequency of said filter.

5. A high power harmonic frequency suppression filter according to claim **3** wherein said electrically coupling means includes slots in the outer conductor of said coaxial transmission line for propagating energy out of said coaxial transmission line and into said waveguide.

6. A high power harmonic frequency suppression filter according to claim **3** wherein said energy that is propagated out of said coaxial transmission line and into said waveguide is energy at said harmonic frequencies.

7. A high power harmonic frequency suppression filter according to claim **3** wherein said absorbing means includes strips of lossy material mounted within said waveguide for absorbing said harmonic frequencies.

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